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THE MUSHROOM GROWERS'
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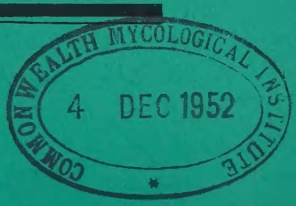

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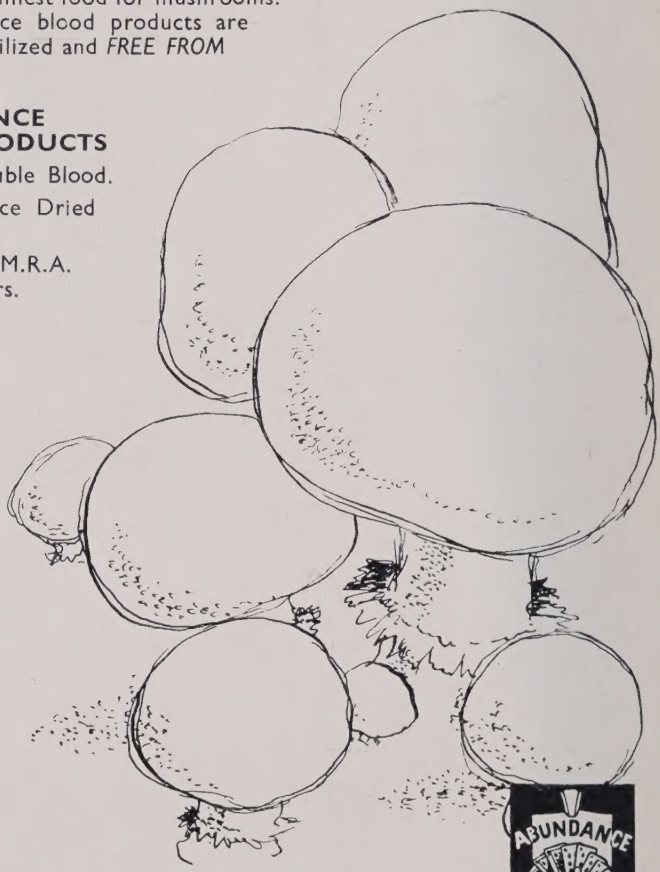

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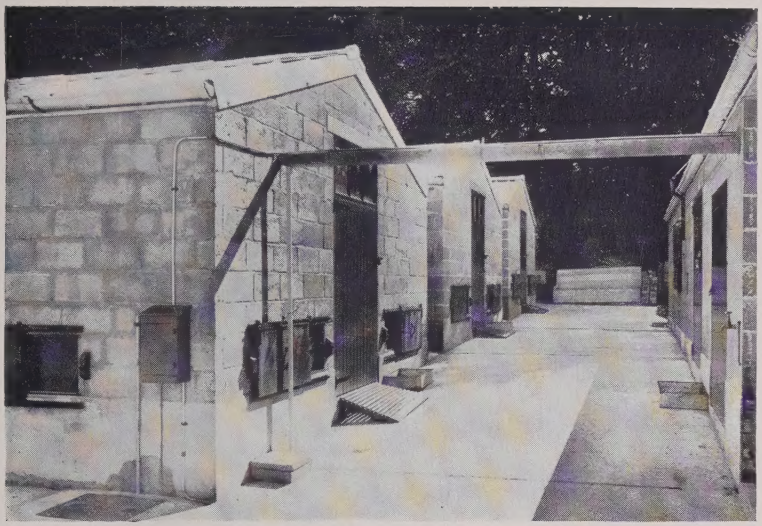

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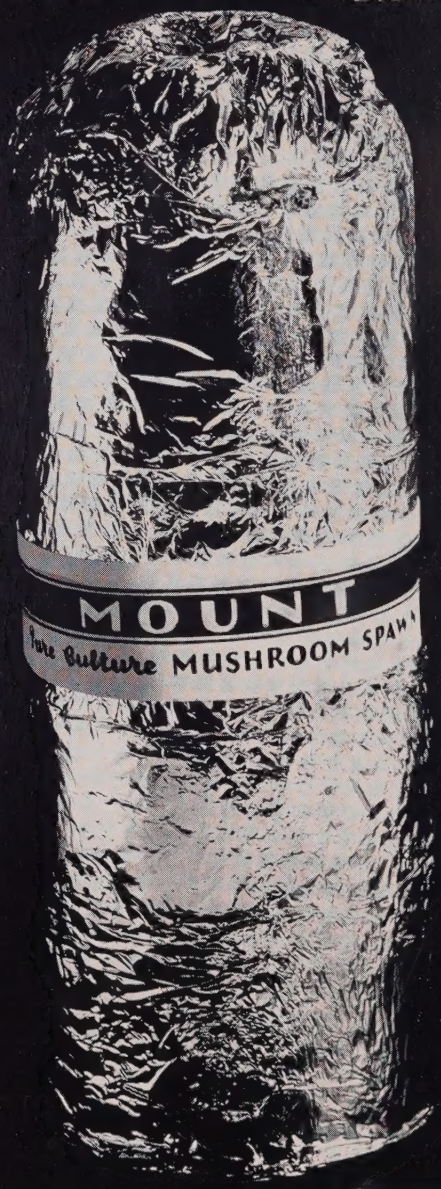


USED BY ALL THE BEST GROWERS

The MGA BULLETIN

DECEMBER 1952
NUMBER 36

EDITORIAL:

WAGES CRISIS

The Horticultural Industry does not seem to have considered adopting by every possible means a vigorously active opposition to the Workers Union's recurring demands for higher wages and shorter hours now that their conditions (of pay and holidays) have been raised to the level of other industries.

This passive attitude on the part of the employers is not due to an indifference to the situation but to a sense of helplessness in the matter as their trade associations do not appear able to speak with a strong enough voice.

What is the Mushroom Grower doing about this and the general, but erroneous, conception among the hierarchy and public alike that the producer of this commodity is enjoying an exceptional income? Mushroom growers should not let such a major problem pass without vigorous action.

The Chancellor of the Exchequer has on several recent occasions proved that present wage demands in general are quite unwarranted for meeting increased costs in living which have slowed down to 1% and seem to be stabilizing, and will do so if claims are reasonable; so why the extra 4½% represented by the latest award of 5/- per week increase for the farm hand?

Workers have found that a frequent demand is followed by an easy success, and their Union has now been instructed to claim a minimum of £7 a week without delay.

No one can suggest that the minimum rate is all the worker receives. Most employers in the industry pay a basic wage above the statutory minimum, and a certain amount of overtime can be earned in addition. As a result of this year's Income Tax family allowances adjustments there is no longer cause for the pretext that tax is a deterrent to overtime earnings.

From being too low in pre-war times, wages are swinging to the other extreme. No one to-day denies a man a fair wage and conditions, but further increases will alter the whole complexion of the industry which is largely carried by the master-grower working unlimited hours, and often harder, for a return lower than the earnings of the labour he hires.

There is already a glimmer of the red warning light of unemployment which the workers should heed, as the grower may reach the limit of his capacity and prefer a steady paid job and its shorter hours of labour.

W. A. B. HARDING (Member, Editorial Board).

Stanley Middlebrook's Diary

Oct. 10. There is a difference of opinion among the pundits about the name for our product. Is it Psalliota bispora or Agaricus campestris? The trade too seem uncertain, so use " Mush " or " Rooms " (derived from the colloquial *Musherooms?*)

Oct. 20. Look at this, you tray men. Take 5 houses (1 as a steam room). Under our conditions at Brayton if we average 1·3 five and a half times a year in the four growing houses, trays have no advantage at present prices over our five houses on shelves at average 2·25 three times a year. At 1·3 *four* times a year trays are useless by comparison. But if the figure at $5\frac{1}{2}$ times a year can be raised to 1·4 trays may be just worth while. At 1·5 they would be definitely better. Work it out for yourselves (it will take you some time), and don't forget (*a*) that fifth house and (*b*) the price of mushrooms. It might be reasonable to say that the higher the average price of mushrooms the more point there is in using trays. Try working that out, too.

Nov. 5. Said a visitor, " My object in making frequent visits to a certain grower is to learn what *not* to do." After a difficult discussion I was convinced he wasn't referring to me.

Nov. 8. This afternoon Mr. Atkins and I went over to Harrogate to make a preliminary survey of the venue for an important 1953 event—a combined Trade Show, Refresher Course and Annual General Meeting. It is to be a two-day affair and we are submitting the following programme suggestion for the Executive Committee's consideration. First day, Refresher Course in the morning, Official lunch, completion of Refresher Course and A.G.M. plus tea in the afternoon. The second day to be devoted entirely to the Trade Show. We were quite pleased with the arrangements and amenities and felt that such congenial surroundings and a two-day effort should provide the ideal circumstances some of us have long advocated for a satisfactory " get together " of growers. Plenty of time to complete those otherwise short, broken conversations of earlier occasions.

Nov. 10. We have just received an official intimation from Harrogate that the Mayor and Corporation would be pleased to give us a Civic Reception and Dance next September. It looks as though next September is going to be quite an MGA occasion!

Nov. 11. You all know what MICROCLIMATE is, of course. You don't? No, neither did the man who spent half-an-hour trying to describe it to me. He said, " It might be MACROCLIMATE I'm talking about, I don't know." This must be a major problem of great importance which when solved will undoubtedly lead to doubled production! The final definitions of both and their inter- or non-intercommunicability may be vital! You may rely on your diarist to relieve the tension next month.

Nov. 13. A grower thinks his summer crop fall was due to hot weather composting in June and July. I prefer to blame the weather conditions during cropping—and the Editor for refusing me space to explain.

Our Chairman's Wife in the Kitchen . . . . . .

THE HARBEN RECIPES TESTED

By **Mrs. BARBARA BOXALL**

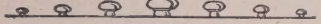
I am one of those unfortunate women who happen to be married to a grower and, as all growers' wives know only too well, anything the nursery produces seldom if ever finds its way indoors. When friends come to our house they always say " How lucky you are to be able to just go out of the backdoor and pick mushrooms whenever you want them!" My reply has always been, " Mushrooms? We never see them!"

But one day recently my husband brought in one of Philip Harben's recipe leaflets* and I thought I'd try some. Much to my surprise, although I do not consider myself a good cook, the results were excellent, and my husband and children asked for more. Now I asked myself why was it that with my first attempts these mushroom dishes were so much better than one gets in restaurants. Was it my good cooking, or Philip Harben's excellent recipes? I am going to share the credit equally with the Television Cook.

Mushroom dishes are now a regular feature in our household, and it is interesting to note that the colour of such a dish as a soup plays an important part in its appeal to children. Take Philip Harben's Economical Soup for instance. It is normally a rich creamy colour and has little or no appeal to children on appearance; but colour it a rich brown and it is a different matter.

I'm sure the same sort of thing applies to grown-ups in restaurants—*the attractive appearance of the dish is half the battle.* Whenever we order mushrooms in English restaurants, what do we get? Nine times out of ten the height of the chef's imagination is mushrooms on toast, with the mushrooms done so black as to be unrecognisable.

To conclude by quoting Philip Harben: " It is beyond all argument and dispute that mushrooms excel all other foods in their power to transform the simplest things into banquet fare. Indeed, so small a quantity of them is needed that the cost hardly comes into the picture at all. It is not only in their flavour that their value lies, but also in their appearance, for a firm fresh mushroom can be cut into a great many neat slices which, tastefully arranged upon a cooked dish, are a pretty sight to behold."



**One of these Recipe Leaflets is enclosed with this Bulletin. They are available at 1d. each from the Secretary, MGA, Yaxley, Peterborough. The Executive Committee hopes all members will help to stimulate the demand for mushrooms by buying a few to distribute among their friends, wholesalers, retailers, hotels and restaurants. Perhaps retailers will co-operate by passing them on to their customers.*

Studies on the Function of the Casing for Mushroom Beds

Part III. The Use and Characteristics of Peat as a Casing for Mushroom Beds*

By **Dr. B. B. STOLLER**

Introduction : In the Duluth, Minnesota area, loam is scarce ; a heavy red clay is prevalent for the most part. But there are immense deposits of peat in this area, so the attempt was made in 1947 to use peat for casing mushroom beds. During the five years it has been the practice to use peat, crops of 2 lb. or more per sq. ft. have been harvested repeatedly.

A reference to the use of peat for casing mushroom beds was found in the publication by Lambert and Humfeld (2), although the writer has been informed that some growers in south-eastern Pennsylvania used peat around 1930, but quickly discarded such practice. Atkins (1) reports briefly that Bewley obtained a yield of 0·81 lb. per sq. ft. of mushrooms on beds cased with peat ; the kind of peat used was not identified ; unfortunately, Bewley's publication is not available to the writer. The peat used by Lambert and Humfeld in their experiments, as well as by the Pennsylvania growers, was produced in New Jersey and is sold under the trade name " hyperhumus." They reported " comparatively high yield was obtained from neutralized hyperhumus, but the mushrooms from the beds cased with this material were inferior in quality because of excessive spotting." No explanation for the spotting is offered, and their reference to peat is altogether minor.

No spotting of mushrooms has been experienced in the use of Minnesota peat, except temporarily in the summer time when the temperature rose to about 70° F. in the mushroom house for a few days. In fact, the mushrooms harvested on peat casing are exceedingly free of blemishes, and have always brought the highest market prices.

Methods of Winning Peat : There may be several explanations for this difference in the growth of mushrooms on Minnesota and New Jersey peats. The chemical and physical properties of both are generally the same, but a difference may exist microbiologically. This difference probably arises out of the methods of winning the peat. The Minnesota peat is excavated from the bogs in the winter when the peat swamps are frozen to a depth of about two feet, and is piled in a heap to allow for drainage in the spring and summer. The peat from the pile is used in this condition, after mixing with calcium salts and screening, as will be described later. But the New Jersey peat is " cultivated " ; that is, the fields of peat are ploughed, sometimes planted with forage crops, which are then ploughed under. Such cultivation might induce the growth of micro-organisms which may contribute to the spotting of mushrooms. Then again, the relative humidity in areas where the hyperhumus has been employed is much higher than in

*The word " peat " usually refers to *fibrous* peat or the " peat moss " of commerce, whereas *non-fibrous* peat is frequently designated as " humus," " hyperhumus " or agricultural peat. Peat with less than 50% organic matter is commonly called " muck." In this article a clear distinction is made between *fibrous* and *non-fibrous* peats.

Duluth ; it is possible that micro-organisms which find the high organic matter of peat a suitable habitat, may grow and spot the mushrooms at the higher relative humidity.

Fibrous and Non-Fibrous Peat : The Minnesota peat is generally considered to be the decomposed remains, more or less, of sphagnum (moss), although the deeper portions of the bog may have originated from aquatic plants. The peat from the upper strata, two feet or more in thickness, has a fibrous structure and is employed for litter, mulches, packing material, etc. The fibrous peat, as will be described later, is unsuitable for casing mushroom beds. The peat from the lower parts of the bog consists of well decomposed material, in which the fibrous structure has been destroyed by disintegration. This non-fibrous peat has been found suitable for casing.

CHARACTERISTICS OF PEAT

Moisture Capacity of Peat : The peat as dug from bog contains 88 to 92% water ; upon drainage, without excessive air-drying, the moisture recedes to about 80%. The peat with 80% moisture or less can be screened satisfactorily, in conjunction with mixing with limestone, through wire-cloth with openings of $\frac{1}{2}''$ mesh. The peat is rather lumpy as dug from the bog ; the lumps may be disintegrated by passing them over a spiked drum revolving at 1,700 r.p.m. When the peat dries to 50% or less, it is difficult to wet again ; it must be sprinkled intermittently for several days before water retention is normal. Peat with 40% moisture is comparable in appearance to air-dry soil (5 to 10% moisture). The " hyperhumus " peat is marketed containing 65% " normal moisture content," according to producers.

Watering Peat Casing : The expertness practised in watering soil casing is unnecessary for watering peat casing : it is not required to hold the sprinkle head upwards to allow the water to gently fall on the soil ; nor is it necessary to refrain from watering except between breaks, for fear of splashing the mushrooms ; nor is there danger of puddling. Beds cased with peat may be sprinkled directly, even on mushrooms, because the peat is firmly held by the permeated mycelium. The few particles of peat that may splash, do not spot the mushrooms, since peat does not smear like soil. In growing mushrooms on peat at 58° to 60° F., the breaks are practically continuous during the first four weeks, so that watering is necessary while mushrooms are on the beds.

Outstanding Characteristics of Peat : The chemical composition of Minnesota peat, hyperhumus and soil is shown in Table 1. The outstanding characteristics which sharply differentiate peat from soil are the very high percentage of nitrogen and organic matter, and the great water-holding capacity. Whereas dry soil will absorb and hold $\frac{1}{5}$ to $\frac{2}{5}$ of its weight of water, peat will retain 2 or 3 times its dry weight of moisture. This enormous water-holding capacity stems from the colloidal nature of the large quantity of organic matter present in peat. The colloidal matter accounts for the cation-exchange capacity of peat being 15 to 20 times greater than that of soil (5).

Nitrogen in Peat : Evidently the large quantity of nitrogen present in peat is almost entirely unavailable to the mushroom mycelium. Soluble nitrogen salts (1% salt or 0·15% N) added to the peat inhibit

fructification. It seems strange that the mushroom mycelium is unable to utilize the nitrogen of peat. According to Waksman (7) the mushroom mycelium is able to attack and decompose the ligno-protein complexes which constitute the " humus nucleus " of organic matter of soils and peat. But he states also that when manure is composted too far, it becomes a poor medium for mushroom production, and that the complete removal of cellulose may render the lignin or the resulting ligno-proteins resistant to attack by the mycelium. It may be deduced from Table 26 of Waksman's data (7) that peat contains relatively little cellulose. The writer attempted to prepare a compost from the " hyperhumus " peat (during compost exp. in Pa.) by the addition of molasses and mineral salts ; only a very fine, grey mycelium grew and no mushrooms were produced. It seems, therefore, that by some process of condensation, the ligno-protein complexes of peat are even resistant to the mushroom mycelium.

Potash in Peat : It is notable also from Table 1, that the potash is distinctly higher in soil than in the peats, and that there is more potash in the ' cultivated ' hyperhumus peat than in the ' raw ' Minnesota peat. It has been suggested in Part II of this series (5) that the mycelium may derive some of its nutrient as potash from the soil, especially if none exists in the compost.

Structural Characteristics of Peat : Fibrous peat or " peat moss " is a standard product of commerce, and is usually sold in bales. It is prepared by shredding and sifting the peat from the upper strata of the bog. It is commonly used for litter, mulches, packing material, etc. As marketed, it contains 30 to 40% moisture. When the moisture is increased to about 65%, and used for casing, the mushroom mycelium grows through it quickly without producing sporophores. But if the peat is saturated with water (about 80% moisture) at the time of casing, sporophore development is normal, although they grow slightly below the surface, perhaps $\frac{1}{8}$" to $\frac{1}{4}$". How saturation of the fibrous peat with water induces fructification, is not understood. It is probable, though, that a beneficial effect is exerted by the complete hydration of the finer non-fibrous particles, and by the settling and compacting of the particles slightly below the surface. It must be admitted, however, that experiments with fibrous peat have been preliminary and scanty, and that the use of non-fibrous peat, being more suitable, superseded further consideration of the former.

The non-fibrous peat occurs in the deeper portions of the bog, where decomposition has proceeded to the extent that the fibrous structure has disintegrated. It is marketed as ' agricultural peat.' The wet peat is black and dries to a dark brown colour. It is highly plastic, but does not pack hard like clay. It makes a good casing medium after mixing with calcium compounds. The colloidal nature, cation-exchange capacity, and pH of this peat has been discussed in Parts I and II (4, 5).

USE OF PEAT FOR CASING

Preparing Peat for Casing : The wet peat as it comes from the bog has pH 5·0. A yield of about 1 lb. per sq. ft. may be obtained with this peat as a casing, even at this low pH, by screening it thoroughly to

break up all the lumps. When the peat is neutralized with finely ground limestone (over 95% $CaCo_3$) a yield of 2 lb. per sq. ft. may be had. Upon first mixing the peat with limestone, the pH attained is 6·0 to 7·0 ; after standing overnight, the pH increases to 7·0 to 8·0—apparently it takes time for the acid-producing substance in the peat to react with the limestone. One pound of limestone to a pail of the wet peat (3 to $3\frac{1}{2}$ gallons or 15 to 17 lb.) is sufficient to produce this change in pH. Upon mixing, in addition, with $\frac{1}{2}$ lb. of gypsum, the peat rolls up into pellets up to $\frac{3}{8}''$ in size. The pellet formation occurs while screening and also when spreading the peat over the bed. The peat appears to have a distinct ' crumb ' structure after mixing with gypsum. The pH is only slightly reduced by the admixture of gypsum, since the limestone is present in excess. By the use of gypsum the yield is increased to 2·5 lb. per sq. ft., or 25% more than with limestone alone. During the five years peat has been used for casing the beds, this combination of limestone and gypsum has been standard practice. The yields with casing prepared in this way have been 2 lb. or more per sq. ft.—sometimes 2·5 to 3·0 lb.

Effect of Adding Chemicals to Peat Casing : While quite a few experiments were arranged in which various chemicals were added to the peat casing, it was not possible in most cases to devote the time-consuming task of keeping a record of the yield from each small plot. Where the emphasis is on production rather than on research, it is frequently necessary to abandon experiments. Nevertheless, some data have been accumulated on the effect of adding chemicals to peat. If these data are confirmed, there may be practical results.

In one series of experiments started in 1947, various fungicides, besides some fertilizer salts, were added to the peat. When these experiments were initiated, the brown plaster mould was prevalent. While it was evident at the completion of the cropping season that this mould was harmless and did not decrease the yield, still, under the new conditions existing in Duluth, it was uncertain what might happen. Accordingly various fungicides, supplied by chemical manufacturers as samples, were mixed with peat as shown in Table II. The chemicals were mixed with 15 lb. (one pail) of peat neutralized with $CaCO_3$ and then spread over 6 sq. ft. of bed surface. To aid thorough mixing, the chemicals in powder form were diluted with 50 grams of talc ; the chemicals supplied as liquid were diluted with 500 ml. water. The peat to be mixed with water was spread out to dry for a few days. To other plots reported in Table II, potash, superphosphate and gypsum were added.

The fungicides reported in Table II are of two kinds : in one, the organic sulphur is the functional radical, and in the other the quinone group. The fungicidal effect of the former is produced by release of sulphide gas ; of the latter, by the direct action of the volatile, oxidizing nature of the quinone. It is evident from the data that the fungicides at a concentration of 5 grams were toxic, and severely diminished the yield. Reducing the concentration to 1 or 2 grams allowed the yield to reach to the level of the control ; however, there was a slight increase by using Phthiocol and Dithane D-14 (5 ml). The Phthiocol

available was insufficient to repeat the experiment, but relatively large-scale experiments were arranged for using Dithane D-14, as well as Arasan and Phygon. The procedure was varied in repeating the experiment, by spraying these fungicides on the surface of the compost and then casing with peat which had been mixed with limestone and gypsum. The yield from the plots sprayed with Arasan and Phygon was the same as for the control, but the yield was 20% greater for the plot sprayed with Dithane D-14. It may be worthwhile to continue further tests with Dithane D-14.

There was no brown plaster mould on the plots in these experiments, so the effectiveness of the fungicides for eradicating this mould under these circumstances could not be appraised. Some experiments, however, were conducted in which Phygon, Dithane D-14, and Arasan were sprayed on the brown plaster mould growing on casing soil. A temporary inhibition of growth, lasting about four days, was observed, but thereafter the mould continued to grow out from the periphery. These fungicides were not tested against such common mushroom diseases as *Verticillium* or *Mycogone*, because none have been experienced in Duluth.

The fungicides mentioned by Yoder *et al* (8), Parzate and Dithane Z-78, were not tested because they were not supplied by the manufacturers ; possibly, they were unavailable at that time. The difference between Dithane Z-78 and the Dithane D-14 mentioned here, is that the former is the zinc salt whereas the latter is the sodium salt of ethylene bis-dithiocarbamate. Yoder *et al* did not attempt to mix these fungicides with the casing soil or spray the surface of the compost before casing as described herein ; they restricted the use of these fungicides to spraying or dusting the casing soil in order to control *Verticillium* and *Mycogone* diseases. Possibly the zinc salts might have a beneficial effect on the yield, similar to the sodium salt, if they were mixed with the casing soil or peat at the proper concentration.

Compounds generating sulphides, such as the fungicides mentioned above, may promote a greater production of sporophores by making the soil a better reducing medium. It has been the contention of the writer that oxidation-reduction reactions enter into the production of sporophores (4). The sulphides would tend to increase the reducing capacity of the soil medium, so that oxidations could occur easier therein. This kind of explanation may account for the enhancing of the yield with Dithane D-14.

Mixing Slag with Peat : Another material generating sulphides upon being mixed with peat is the slag produced by the iron company in Duluth. The original intention in experimenting with slag was to find a substitute for peat and gypsum, since slag is available without cost. The slag produced in Duluth consists of CaO—43·26%, SiO_2—36·13%, Al_2O_3—15·26%, minute quantities of Mg, Mn, and Fe, and finally S—1·54%. The sulphur is present as calcium sulphide (3%). Upon mixing the slag and acid peat (pH 5·0), hydrogen sulphide is generated immediately, as may be detected readily by the odour. The pH of the slag is 8·0 and of the peat 5·0 ; upon mixing half and half, the pH is reduced to 7·5. The hydrogen sulphide is generated by an ordinary

double decomposition reaction (ex : 2 H′ ions + CaS ⟶ Ca″ ion + H_2S). As the Ca ions are exchanged for the H ions in the colloidal complex of the peat, the pH increased and the generation of hydrogen sulphide was inhibited. In fact, the extent of evolution of H_2S from a mixture of slag and peat could be controlled by varying the amount of $CaCO_3$ added to the mixture. The H_2S is generated only by acidification.

In one series of experiments conducted with the slag and peat, the slag was added to the extent of 10% to 50%. $CaCO_3$ was added also to this mixture in amounts varying from 6 oz. to 18 oz. per pail (15 lb.) of peat. Since twenty-four variations were attempted, plots with an area of only 1 sq. ft. were arranged ; there was too much variation between the small plots for the results to be significant. However, when the average yield of four plots to which no slag or only 10% was added, compared to the average yield of four plots each to which 20% to 50% slag was mixed, it was evident that the yield was increased 50% by adding more slag. It may be surmised too that as the percentage of slag was increased, the amount of $CaCO_3$ had to be increased also to obtain the best yields. Larger scale experiments were also conducted, but no account of the yields could be recorded. The chief objection to mixing slag with peat for casing beds was that, under the low relative humidity prevailing in Duluth, the casing material dried out too fast. Slag is a highly porous, coke-like material ; in spite of the high moisture content and great water-retaining capacity of peat, it dries out rapidly by mixing with slag. Under conditions of higher relative humidity, or if it were ground up finely, slag may be useful.

Mixing Potash and Gypsum with Peat : Other results to be noted in Table II are the effects of adding potash, superphosphate and gypsum to peat neutralized with limestone. There was an increase in yield of some 35% by adding potash or gypsum, but the yield was the same as the control when superphosphate was added. As stated previously, it has been the standard practice to mix gypsum and limestone with peat, but further tests with potash have not been attempted. The use of gypsum was favoured because it had a flocculating or pelletizing effect on the wet peat coming directly from the bog. Furthermore, the function of gypsum as a flocculating agent has been adequately demonstrated by Pizer (3), whereas the usefulness of potash was not evident as long as sufficient quantities existed in the compost. It may be worthwhile though, as suggested in another part of this series (5), to conduct further experiments on adding potash to the casing material.

Yields from Peat Casing under Ideal Conditions : The yields reported in Table II were harvested over a period of four weeks during the month of May, and then had to be abandoned. In view of the short cropping time, it seems the size of some of the yields are remarkable. Yet further consideration of the circumstances under which the mushrooms were grown, leads one to expect as much. The mushrooms were produced from a synthetic compost of straw, wet brewers' grains and the usual fertilizer salts (6). The temperatures during the ' sweating-out period ' were sufficient to kill all pests, especially on the top or fourth bed where the tests were conducted. During the month of May, the weather in Duluth is ideal for growing mushrooms : the

ventilators may be left open almost continually, the heat in the mushroom house is uniform, and the relative humidity is satisfactory. Given a satisfactory compost, a desirable casing material, freedom from pests, and ideal environmental conditions, it may be expected that a large yield will be produced rapidly. In regards to the speed of production, it was observed that a yield of 1·3 lb. per sq. ft. was derived from plots Nos. 11, 15 and 17 during the first ten days of cropping ; similarly, the yield was approximately 1·0 lb. per sq. ft. from plots Nos. 9, 12 and 16 after ten days, and from plots Nos. 2, 4 and 7 after twelve days. Besides, mushrooms grew almost as numerously in the fourth break as in the earlier ones.

MUSHROOM GROWTH ON PEAT CASING

The Layer of Peat Casing : The wet peat occupies about the same amount of space as loam, so that, volumetrically, the amount of peat required to case an equal area of bed surface is the same as for soil. The weight of the wet peat (containing about 80% moisture) however, is about half as much as that for an equal volume of soil, since the specific gravity of most loams is 2·6 (compared to 1·0 for water). Accordingly, the weight of a layer of peat one inch thick weighs about half as much as a similar layer of soil. In estimating the thickness of a layer of peat it is necessary to tamp the peat, because it is so loose when spread over the bed—unlike soil casing, which is fairly compact by levelling off with the back of a rake.

Effect of Tamping Peat Casing on Mushroom Growth : Where the peat had not been firmly tamped, mushrooms appeared in the fissures of the irregular surface. While the mushrooms are numerous, they are small and have relatively thin stems. It seems as if the moisture available to the mushrooms was insufficient. It may be assumed, reasonably, that by compressing the peat the mycelium would be in closer contact and absorb water more readily. It is the standard practice in using peat to tamp the beds firmly with a trowel-like implement. On tamped beds the mushrooms grow large with stout stems. The susceptibility of the character of the sporophore growth to the firmness of the casing on peat more than on soil is probably due to the lighter and looser texture of the former.

Dense Growth of Mycelium in Peat Casing : The sensitivity of the mushrooms growing on beds cased with peat to insufficient ventilation, and the discolouration produced in mushrooms growing at 50° F., has been mentioned previously (4, 5). It is possible these two effects may be related also to the dense growth of the mycelium in the peat casing. The ventilation or oxygenation of the mycelium in the casing may be more difficult on account of the exceptionally dense growth in the peat casing. For the same reason, absorption of water is facilitated by the greater mycelial development. Also notable is that where holes left from cropping have been refilled with new peat, the mushrooms appear in clusters again ; apparently, the reduction in oxygenation by the density of the growth has been corrected, or staling products accumulated in the casing have been removed. Recasing a house with new peat after a yield of some 2 lb. per sq. ft. has been attained, permits the gain of at least another 1 lb. per sq. ft. The recased layer need not be more than ½″ thick.

TABLE I. COMPOSITION OF MINNESOTA AND NEW JERSEY PEATS AND OF A REPRESENTATIVE SOIL, EXPRESSED AS PER CENT.

Constituents	Peat (Minn.)	" Hyperhumus " (N.J.)	Soil
Nitrogen (N)	2·25	3·25	0·2
Phosphoric Acid (P_2O_5)	0·18	0·29	0·15
Potash (K_2O)	0·07	0·28	2·0
Sulphur (S)	0·27	—	0·06
Ash	12·0	8·5	96·0
pH	5·0	5·8	—
Organic Matter	88·0	91·5	4·0
" Normal Moisture "	65—75	65	20—30

TABLE II. EFFECT ON YIELD OF MUSHROOMS BY MIXING CHEMICAL SUBSTANCES AND PEAT NEUTRALIZED WITH $CaCO_3$. YIELD AFTER CROPPING 31 DAYS

No.	Grams per 15 lb. wet peat	Substance (Trade Name)	Chemical formula and Manufacturer	Yield lb. per sq. ft.
1	—	No Addition	(pH 5·0)	1·1
2	—	($CaCO_3$)	(pH approx. 7·0)	2·0
3	5	Tersan	Tetramethyl thiouram disulphide—50% —Dupont	0·3
4	2	Arasan	Tetramethyl thiouram disulphide—50% —Dupont	2·2
5	5	Fermate	Iron dimethyl dithiocarbamate—Dupont	0·8
6	5	Zerlate	Zinc „ „ „	1·0
7	1	„	„ „ „ „	2·0
8	5	Spergon	Tetrachloroquinone—U.S. Rubber	0·3
9	1	Phygon	2,3 dichloronaphthoquinone—U.S. Rubber	2·0
10	5	„	„ „	1·0
11	0·5	Phthiocol	2,3 methyl, hydroxy naphthoquinone —Velsicol	2·3
12	5*	Dithane D-14	Disodium ethylene bisdithiocarbamate—19% —Rohm & Haas	2·4
13	15*	„	Disodium ethylene bisdithiocarbamate—19% —Rohm & Haas	2·0
14	—	—	Soil**	0·6
15	25	Potash	" Pink " muriate of potash—60% K_2O	2·7
16	25	Superphos-phate	20% P_2O_5	1·9
17	450	Gypsum	(No talc used for diluting)	2·7
18	—	—	Soil**	0·7

*ml.
**Soil was good loam. Not known why yield was so low with soil

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SUMMARY

1. **Moisture Capacity of Peat :** Peat will retain 2 to 3 times its dry weight in water, whereas soil will absorb and hold only $\frac{1}{5}$ to $\frac{2}{5}$ of its weight of moisture. After the mycelium grows into the peat casing, the peat must be almost saturated with water (80% moisture) to initiate fructification. The expertness in watering is not required for beds cased with peat.
2. **Outstanding Characteristics of Peat :** The characteristics which sharply differentiate peat from soil are very high percentage of nitrogen and organic matter and great water-holding capacity.
3. **Nitrogen in Peat :** While peat may contain 2, 3 or more per cent. N, it is insoluble and unavailable to the mushroom mycelium. Soluble N added to peat inhibits fruiting.
4. **Potash in Peat :** Only minute amounts of potash are present in peat—less than in soil. Addition of potash to peat casing may increase yield.
5. **Structure of Peat—Fibrous and Non-Fibrous :** Fibrous peat is unsuitable for use as a casing for mushroom beds. Non-fibrous peat (but not muck) has been used as a casing material for five years, and crops of 2 lb. or more per sq. ft. have been harvested repeatedly.
6. **Preparing Peat for Casing :** To prepare the wet, acid peat (pH 5 0) as it comes from the bog, it must be mixed with about 6% limestone and 3% gypsum, and screened.
7. **Mixing Chemicals with Peat :** Of the many chemicals tested by adding to peat, an increase in yield appears to have been obtained with Dithane D-14.
8. **Mixing Slag with Peat :** By mixing with slag, the aeration through peat is improved, but the casing dries out too rapidly.
9. **Yields from Peat Casing under Ideal Conditions :** Yields as high as 1·3 lb. per sq. ft. in 10 days of cropping have been obtained with mushrooms growing on a peat casing under ideal conditions.
10. **Effect on Mushroom Growth by Tamping Beds Cased with Peat :** When beds cased with peat are not tamped, the mushrooms are numerous, but are small, have relatively thin stems, and open quickly. Mushrooms produced on beds that were firmly tamped were large with stout stems.
11. **Mycelial Growth in Peat Casing :** The mycelium grows very densely in peat casing. The effects of dense growth may be an explanation for sensitivity to ventilation and for better water absorption.

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An American's Views on the MGA

Dr. A. M. Kligman writes to the Editor

Dear Fred,

I had intended to communicate to you my impressions of my recent visit even before you suggested that I record them for the *MGA Bulletin*. Indeed, although you ask for comments about the British Mushroom Industry, I would find it exceedingly difficult to isolate my reactions on this particular subject from my total cultural and human experience in Great Britain. You must remember that I tried to see England not solely through the eyes of a visiting mushroom specialist, but also as a physician, and as an American aware of the urgent need for sympathetic co-operation between our two countries.

You know already that I was tremendously impressed with England and her people. I had more fun on the Continent (the British do, too!), but above all it was England who inspired in me the greatest admiration. Nowhere else did I find as much social consciousness, enterprising spirit in the face of deadly restrictions, and sheer determination to maintain the country in a thriving, vigorous state. Although in America we often ridicule the English code of honour, closer inspection shows it to be a durable, workable set of principles for living with dignity in the civilized community. Your people are serious and progressive. I did not meet a grower who was not aware of the major trends in modern mushroom growing. Everyone was extremely keen to learn new things and to explore the possibility of new techniques. Certainly, the British Mushroom Industry is not at all backward. In fact, **through the leadership provided by the MGA, a programme of research and education has been inaugurated which cannot fail to raise the general competence and productivity of the average grower.**

In America we have a few very advanced, highly industrialized, ultra-modern plants which probably surpass anything in the world; the over-whelming mass of mushroom growers, however, operate on a very small scale. Often their methods are primitive and their yields low. The American small grower has little contact with the very large one. The extremes are greater than in England. There is certainly no organized means for the larger growers to communicate their experiences, and usually superior methods, to the smaller growers. In short, although there are no official barriers, regional meetings at particular plants do not occur and there is not the massive sharing of information and the practical demonstrations which are commonplace with you.

Growers in America work largely independent of each other although I do not mean by this that they are basically secretive. They have just not found the way, as yet, to pool their intelligence as effectively as this is being done in England. In America, the chief source of everyday information is the spawn maker. He plays the rôle of trouble-shooter and generally renders a valuable service. This is somewhat true of England also, but more and more I believe your association will take over this job and do it better.

I have the distinct impression that few of you actually comprehend what you have accomplished with your organization. It is obvious that

you are having labour pains and are confronted with the human problems which usually arise when the strong are urged to lie down with the weak for the common good. There probably never has been a young organization in which the leaders periodically did not suffer frustration and disappointment from the lack of enlightenment often exhibited by the rank and file. There are within human beings strong anti-social, as well as pro-social, impulses. The history of civilization has been one of inducing men to control their anti-social impulses and to join together for mutual progress.

This is a difficult precept to follow but certainly England is doing this very thing on the national level. At first the big growers will seem to be contributing more to the substance of your organization, but in the end, owing to research and the free exchange of information, even the large growers will profit. This means that you and Middlebrook and the others who have done yeomen work in organizing the British Mushroom Industry must continue to proselytize, to educate and to give unstintingly of your effort and spirit.

I can assure you that **real progress is impossible without serious scientific research.** Unhappily, we in America are no longer highly active in mushroom research. This rôle logically passes to England. The collapse of the MGA in England would be a catastrophe to you and to all others who are interested in the advancement of the mushroom industry the world over. After seeing the progress you have made in such a short time, such an idea is unthinkable. I am convinced that although this is not England's brightest hour, you all face the future with the toughness and enterprise that will yet restore your pride. There are qualities in English culture and tradition which are worth teaching to the rest of the world. One might mention because it is of current interest that we in America admire the integrity of your civil servants and the solidity of the whole English judicial system. Your country has a tradition for substantial and honest leadership, which I am sure will help sustain you (even if unconsciously) to continue your splendid efforts for the MGA.

I like England, Fred. I found the people alert, industrious and spiritually uplifting. Perhaps your people, more than any other, are engaged in a life and death struggle to prove that civilized habits of co-operative living are worthwhile. I have the feeling that in certain other countries in Europe each individual is so spiritually exhausted that he largely looks out for himself; whereas in England it is more apparent that each individual tries to look out for England's needs as well as his own. As we say in America, I am convinced that you have the stuff and will deliver the goods.

Incidentally, I did not find English hospitality as stuffy and cold as it is reputed to be. I was certainly treated in a very warm way, although this sensation, I admit, may have been a consequence of high alcoholic blood levels! I am greatly indebted to you for making this experience possible. I immensely enjoyed every person to whom I spoke. I do hope that some day I shall have the opportunity to return your kindness in America. Sincerely yours,

AL KLIGMAN.

M. C. LUXMOORE *emphasises . . .*

THE SIGNIFICANCE OF THE GROWING HOUSE

At the last Refresher Course in Peterborough, I attempted to give reasons for supposing some progress had been made in mushroom house design, and I contended that all types of houses had a maximum potential out-put. (At that time I was in the toils of building a new plant.)

The suggestion was made that the buildings themselves were of paramount importance in the production of quick and heavy crops, and I am persuaded by checking through records that this is indeed a fact. It is not my intention to belittle growing ability; but to observe the rules, and then fall short of the target without being able to lay the blame on disease, is a common enough experience. The growing house, by virtue of its seeming permanency, often escapes the grower's condemnation, or if alteration is recognised as necessary, the expenditure is deemed too heavy. Building is expensive, but so is the continual loss of time and part of the crop.

Details of our first five crops are now available, and it should be borne in mind that they were taken during the summer months, and that we used synthetic compost for which a new technique had to be mastered. Our supposition is that we have not mastered it completely, and that the hope of heavier cropping in the future may not be unreasonable.

The first two crops were badly affected by using creosote on unseasoned wood, and might have proved a serious loss; however, with careful nursing and owing to the flexibility of the ventilation, we managed to take two pounds to the foot in eleven weeks. I am persuaded that, in less carefully constructed houses, these two crops might well have been a write-off.

The following two houses were not subjected to creosote and fulfilled our hopes of two-and-a-half in eleven weeks. It was possible to keep the houses moderately cool, and ventilate freely at night, despite the difficult summer conditions. Crop No. 5 at the time of writing has reached its 2½ lb. in eight weeks.

The experienced grower is handicapped by anything but the best type of growing house; to the inexperienced the handicap may prove fatal.

By good fortune the correct weather and atmospheric conditions may help to produce a heavy crop in a barn, or without cover at all, but this may well prove a snare and delusion. Mushrooms are too costly a crop to risk under corrugated-iron shelters. Consistency in such circumstances is impossible—and **consistency is the key to success.**

EDIBLE ASPECTS

Anyone can cook almost anything, so long as the kitchen has space, comfort, and a fairly even temperature.

PHILIP HARBEN in *Woman's Own*, 26.4.51.

Successful commercial production (of **mycelium** grown in waste materials from fruit-canning factories) would mean a cheaper source of "mushrooms" for mushroom soup.

Science News Letter (Washington, D.C.) 27.10.51.

It is well to see in print the straightforward statement that the major virtue of "button" mushrooms is decorative, and that the **full taste** and quality is only to be found in the fully ripe and open mushroom. **JOHN ARLOTT** in *Evening News*, 2.7.51.

There was (in Paris, of course) that cosy place in the narrow Rue des Mathurins, just behind the Opera, where champignons came, according to taste, by way of hors d'oeuvre, steeped in mayonnaise, or fried, with poulet rôti.

W. CURRAN REEDY in *Wine and Food*, Spring, 1951.

I supplied the first rhubarb ever to be canned and processed. . . . . There is no great difficulty in **canning mushrooms.** Experiments were carried out in my own cannery, and creamed mushrooms (sliced mushrooms in thick white sauce) were canned without difficulty. It is essential that growers should have control of their own canneries rather than send to commercial canners. This is another activity that ought to be handled by a growers' co-operative. **T. B. BROOK**

in *Grower*, 17.11.51.

ITEMS OF INTEREST

Mr. Fred. C. Atkins has been invited by the BBC to talk on Mushrooms for five minutes in Roy Hay's "Home Grown" programme on the Home Service on Sunday, 14th December.

This Bulletin (now raised in price, incidentally, to 5 -) is listed in the monumental World List of Scientific Periodicals for the years 1900-1950 with *MGA Bull* as the recommended abbreviation.

Mr. E. B. Watson, B.Sc. (Hort.), of London University (Wye College), has joined the technical staff of Vitax Ltd. of Ormskirk. Mr. Watson, who will be based at Ormskirk but whose work will take him to various parts of the country, will be engaged mainly on field advisory work and in organising and supervising field trials of insecticides and fungicides.

A Bronze Medal was awarded the MGA for its display of mushrooms and literature at the Autumn Show of the Cambs. NFU (Horticultural Section) on 29th and 30th October. The Stand was taken at the invitation of Mr. R. L. Allen, of Royston. Mr. Angus Watson attended, answered numerous questions from growers, and distributed mushroom-recipe leaflets among likely members of the public.

How the Tray System is Working Out in Practice

By J. L. KESSLER

I was very interested in Mr. W. A. B. Harding's " Reflections on the Tray System " in the July issue of the MGA Bulletin. Perhaps my experience too may be of interest to your readers ?

For two years in succession we have put down a winter crop of mushrooms in a 150′ × 28′ glasshouse at Dingley Nurseries, arranged with 3-tier, 7″ deep beds on orthodox wooden staging in the centre and with a double row of trays on each side stacked in the usual staggered tray method and containing 4″ to 5″ depth of compost. Owing to the difficulty of raising the temperature sufficiently, peak-heating was not practised.

On the first occasion, the beds did somewhat better than the trays, the latter producing too many small mushrooms, while the beds gave a heavier crop of good quality ; but on the second occasion, last winter, the yield from the trays was quite as good as from the beds and the quality somewhat better as the beds bore too many very large mushrooms that were difficult to pack and made poor prices.

I entirely agree with Mr. Harding that good ventilation is absolutely essential with trays and the fact that last winter's results reversed those of the previous year may have had something to do with the milder weather that enabled us to give more air, to the undoubted advantage of the trays.

The incidence of small mushrooms—certainly more prevalent on trays—seems to me to be connected in some way with the quality of the manure and the state of the compost, though it may be aggravated by inadequate ventilation. At our Fresh Acres Nursery, Angmering, where the Two-Zone installation has now been in operation for nearly four years, we at first obtained good yields of high quality, but in the second year we ran into trouble with small mushrooms and Red Geotrichum which greatly reduced the crops. We changed our ventilating routine and reduced the number of trays per house and things improved again in the winter, but last summer we were once more up against it.

I sent specimens of compost to be examined and eelworm, springtails and several injurious moulds were discovered. This called for drastic action. After first trying out a few, we treated all the trays with copper sulphate and then with bitumen paint ; we made the addition of BHC dust to the compost at the filling stage a regular routine ; we endeavoured to standardize manure supplies by taking them from one source only and added care was given to cleanliness generally ; we improved the heat-insulation of the growing-sheds ; finally we slowed down the cooling-off process after peak-heating.

Generally speaking the quality and yield are now quite good, but we still get an odd house from time to time that gives us very small mushrooms and nearly always its final yield is lower than the normal, but we don't know just why.

We still stack in the usual way for trays and have not added any corner-posts as Mr. Harding has done ; we use our fans but little and rely for ventilation mainly on opening the double doors at both ends of the growing-sheds for at least an hour each day, depending upon weather conditions. In our rather exposed position, we can usually depend upon their getting a good blow through. We crop our houses only three times per year each and we like to leave them empty and open to the wind for a week between crops.

In my opinion the Tray System is a good one if one has a complete, compact Two-Zone plant designed and set up for the purpose, but rather than half-measures I would prefer shelves, so my views are really not so much at variance with those of Mr. Harding after all !

OZONE AT PEAK HEAT

According to British Patent 669047 taken out by H. & H. Knaust, ozone is used during curing (peak heating) of compost by passing into the house a stream of air containing 1—4 p.p.m. of ozone.

VISITS TO NOBLE MUSHROOMS LTD.

The Directors of Noble Mushrooms Ltd. have reluctantly notified the MGA that they can no longer allow casual visitors at all times and on any day. Visits will normally be permitted on First Thursdays provided there has been a prior appointment, but " even then, we would much prefer visitors who are members of one or both of the Yaxley Associations."

The MGA Secretary has replied: " I am instructed by my Executive Committee to convey to you the deep appreciation felt by all members for the manner in which you have allowed your farm to be inspected by visitors each month. My Chairman considers it a privilege that visits should still be permitted, even by appointment."

NEW (OCTOBER) MEMBERS

Baring, J. T., Longmead Brickworks, Bishopstoke, Eastleigh, Hants.
Brickell, N. G., 81 Corsham Road, Whitley, Melksham, Wilts.
Brook, J., Woodleigh, Wakefield Road, Morley, Leeds, Yorks.
Coates, Fred., Rivelin Nurseries, Course Lane, Newburgh, Wigan, Lancs.
Driffill, E. J., Tom's Hill House Cottage, Aldbury, Tring, Herts.
Forsythe & Son Ltd., W. J., Fairview Nurseries, Bangor, Co. Down, Northern Ireland.
Gay, S. J., 2 Rose Villas, Queens Road, Griggs Green, Liphook, Hants.
Green, W. Howard, c/o Concord Foods Inc., Concordville, Pa., U.S.A.
Hagger, C., The Maples, Melbourn, Nr. Royston, Herts.
Kumst, Cyril, Old Barn, P.O. Roodekop, South Transvaal, S. Africa.
Luxmoore, H. B., S. Vet S. Singa, BNP, Sudan.
Meyer, A., Kwekerij Landgoed ' de Rosep,' Oirschotsedijk, D. 386 A, Oisterwijk, (N. Br.), Holland.
Middleton, J., Little Hempsted, Lyminge, Folkestone, Kent.
Monaghan, J. B., The Park, Mullingar, Eire.
Muijzenberg, Dr. E. W. B. van den, Institut Voor Tuinbouwtechniek, Wageningen, Holland.
Palfrey, E., 32 Manor Park Gardens, Edgware, Middlesex.
Perrier, D. G., Floriana Augres, Trinity, Jersey, C.I.
Poulton Ltd., J., Eastcroft Farm, Windlesham Road, Chobham, Surrey.
Rempe, Dr. H., Meisenburgstr 97a, Essen-Bredeney, Germany.
Snowdon & Co. Ltd., C., Castlefolds Market, Sheffield, 1.
Umpleby, T. B., Sunnyside, Hayton, Yorks.
Wilson, J. S., Aqualate Park, Newport, Salop.

CORRECTED OR CHANGED ADDRESSES

Nagel, Dr. W., c/o Edepilz Champignonzucht, Mannheim Industriehafen, Waldhofstrasse 252, Germany.
Winslade, Miss M. G. D., 3 Hadley Road, Combe Down, Bath, Somerset.

(*Italics indicate Honorary Membership*)

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NEWCOMERS TO THE MGA EXECUTIVE

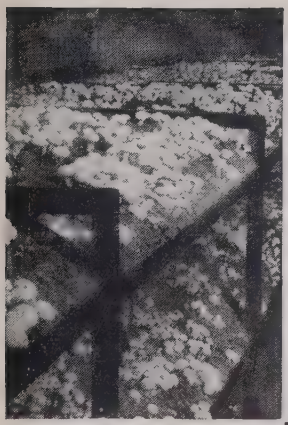
Mr. Jack R. Ashton, our new Vice-Chairman, is 43. He started market gardening as a youth in partnership with his father and learned the business the hard way, by trial and error. He now specialises in growing mushrooms and, under glass, tomatoes and lettuce at Tarleton, a few miles from Southport, Lancs. For some years he was a member of the NFU Central Horticultural Committee and Chairman of the Horticultural Development and Education Committee. He spent six months in 1948 travelling the U.S. and Canada with a Nuffield Scholarship studying market gardening and mushroom growing. He is a member of the Lancs. County N.F.U. Executive and is on the Editorial Board of *The Grower*.

Mr. George V. Allen, one of the earliest member of the MGA, was born in Southern Rhodesia in 1911, educated at St. Edward's School, Oxford, and after training as an Accountant went out to the Gold Coast as a trader for Lever Bros. He took up mushroom growing in Kent in 1937, and is now growing entirely on the Tray System with 14,000 ft. in continual production. He served during the war as a Lieutenant in the R.A. (H.A.A.). Married, with two children, he is a member of the MGA Kent/Surrey/East Sussex Area Sub-Committee, and local district Councillor for East Ashford R.D.C.

Mr. F. Bleazard is the Managing Director of C. Bleazard & Son Ltd., Blackpool, and is a comparative newcomer to the Mushroom Industry. He started growing commercially on shelves in disused poultry cabins lined with asbestos sheets in 1945, and has recently extended by the use of trays in blacked-out greenhouses. A firm supporter of the MGA and the MRA, he fully appreciates the assistance received from these bodies. He is one who believes that he cannot afford to miss attending Open Days, Refresher Courses, and other meetings in order to keep abreast with the times; a gathering without F.B. is something of a rarity—EDITOR.

HEARING ADJOURNED

A case at Epping, Essex, in October against Mr. William Henry Stevens, of The Drive, South Woodford, and Mr. John Lovell, of Banbury Road, Loughton, was adjourned indefinitely when Mr. Stevens was taken ill.



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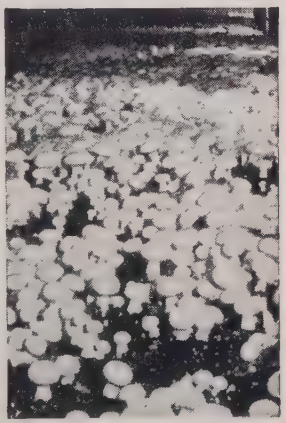

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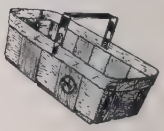

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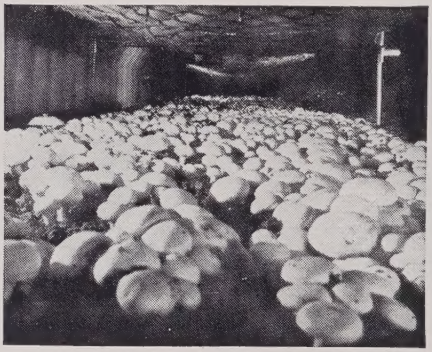

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